A Simple DC Motor

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| --- | --- | --- | --- |
| Item Description | Qty Per Group | Item Description | Qty Per Group |
| Battery | 1 | Wire with ends stripped | 1 |
| Neodymium Magnet Disk | 1 | Metal Screw | 1 |
| Compass | 1 | Notebook or Paper | (as needed for observations) |

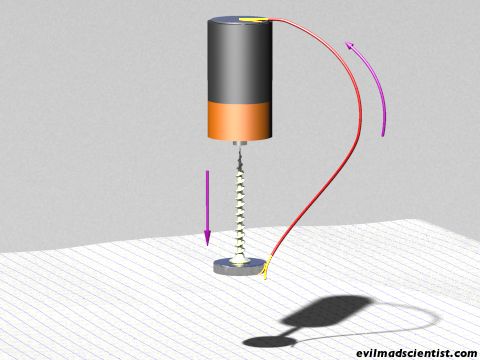
Note: Magnets should be stored away from compasses. When testing the magnets for polarity, do not bring them into direct contact with the compass or you will damage the compass.

*Explore magnetic fields and the compass:*

You may need to review how a compass works. It’s important to note that the North/South convention used for magnetic fields is a just an agreed upon convention. The "North" pole of a magnet defined by the National Bureau of Standards (NBS) is based on the following: "The North Pole of a magnet is that pole which is attracted to the geographic North Pole. Therefore, the North Pole of a magnet will repel the north seeking pole of a magnetic compass."

Gently remove the disk magnet from the screw and battery as necessary. These magnets chip easily, so be careful in handling them.

Use a compass to identify the poles of your disk magnet, but DO NOT touch the compass with the magnet. Simply bring the magnet near the compass and observe the deflection of the compass needle. Use a pencil or other marker to label the poles of your disk magnet with N and S respectively. Do not use tape since it may prevent current from the battery from flowing through the magnet.

Build and explore the Simple Motor As Pictured

Begin with the North Pole of the magnet connected to the screw head and the (+) terminal of the battery down as shown. Note that the wire makes contact with the side of the disk magnet.

North

Disk Magnet: field pointing out the North Pole into the South Pole

1. If you are able to create a spinning motor, write down the orientation of the magnet and the direction of spin for the disk and screw. For this example, the North Pole is up. Is the spin direction ***clockwise (CW)*** or ***counter clockwise (CCW)***)?
2. Once you have had success with building a spinning motor as found in the diagram, try changing the point of contact between the wire and the disk magnet. For example, you should try touching the top of the magnet with the wire; the bottom; the side opposite the diagram. Take notes on the behavior of the screw with each change.
   1. Does the point of contact with the wire and magnet matter?
   2. Does the screw change spin direction based on where the wire makes contact?
   3. Which contact point between the wire and magnet provides the best result?

Explore further:

1. Reconfigure the components of your motor by varying the orientation of the magnet and battery one component at time. Recheck the spin direction with each change. Be sure to write down the change and the direction of spin for each combination of battery and magnet.

Looking for patterns in your observations:

1. At this point, you may have realized that both the direction of the battery (current) and the orientation of the magnet play a role in the direction of spin for your simple motor. In order to identify a pattern for the spin direction based on the orientation of the magnet and direction of current flow from the battery, create a table that summarizes your observations. Use symbols like N, S, +, -, CW, CCW.

Explain:

1. Draw a new diagram of the construction for each of the four possible combinations for current and magnetic field orientation for your motors. By convention, current is considered to flow out the plus terminal of the battery. Use an arrow to indicate the current direction in your diagrams. Also by convention, magnetic fields are considered to “point” out and away from the North Pole and around and into the South Pole. Use an arrow to indicate the magnetic field direction in each of your 4 diagrams. Now add an arrow indicating the direction of spin. Note, this arrow should be either into the page or out of the page. Some texts use a solid dot to indicate an arrow coming toward the viewer (out of the page) and an X to indicate and arrow moving away from the viewer (into the page).

Defer to your teacher for the hand-rule you should use for determining the direction of the force resulting from the perpendicular motion of a charge in a magnetic field.

1. Now use the hand rule for determining the direction of the Lorentz Force to confirm the observations summarized in your table. When necessary, reconstruct (retest) the motors that do not behave according to the hand rule specified by your teacher.